

Answers and Hints to Exercise Questions in “Solar System Dynamics”

(Last Updated: 1 September 2006)

Chapter 3

Q3.1 Note that the angular separation should be 23.9° and not 23.5° . See error listings.

Q3.2 (i) $\bar{A} = 4 + 3\alpha$. (ii) $\bar{A} = 4 - 3\alpha$. (iii) $\bar{A} = 1 - 3\beta - (7/8)\mu_2 \approx 1 - (3/2)\beta \approx 1 + (7/8)\mu_2$.

Q3.3 You need to make use of the masses of Jupiter and Io to calculate the distance of the Io–Jupiter L_1 point from Io in units of the semi-major axis of Io’s orbit. Remember that in our system of units Io has unit mean motion and therefore 2π time units correspond to one orbital period of Io. Remember that the growth away from an unstable point is exponential. The answer is 1.794 days.

Q3.4 Be warned that there are several incorrect ways to get the right answer and so the detail is important!

Q3.5 (i) $x_0 = 1.92$. (ii) $x_0 = 2.47$. (iii) $x_0 = 2.49$ gives $x_{\max} = 12.3256$ following encounter. Because some of these trajectories are in chaotic regions it is possible that your answers could be slightly different from these.

Q3.6 Note that \mathbf{r} and \mathbf{v} are the position and velocity vectors in the inertial frame and that the necessary theory is given in Sect. (3.14.2), not Sect. (3.15.2). See error listings. Remember that in the approximation we only need to include terms of $\mathcal{O}(k)$ and we can neglect terms of $\mathcal{O}(k\mu_2)$ and higher. Also, the unshifted L_4 and L_5 points are located at $r = 1$.